

Microbial Growth and maintenance

General Microbiology

Medical Laboratory Technology (MLT), Part-I, 1st Semester, 2022

Sources of Carbon, Energy and Electrons

- ▶ **Energy source**
- ▶ **Phototrophs:** use light as their energy source
- ▶ **Chemotrophs:** obtain energy from the oxidation of chemical compounds (either organic or inorganic).
- ▶ **Electron source**
- ▶ **Lithotrophs:** A microorganism that uses reduced inorganic substances as a source of electron donors to drive energy.
- ▶ **Organotrophs:** A microorganism that obtains electrons from reduced organic substances.
- ▶ **Carbon source**
- ▶ **Autotrophs:** organisms that use carbon dioxide (CO₂) as their sole or principal source of carbon.
- ▶ **Heterotrophs:** organisms that use reduced, preformed organic molecules as their carbon source for growth. (glucose, amino acids)

Major Nutritional types of bacteria

▶ 1- **Photolithoautotrophs**

- ▶ A microorganism that oxidizes reduced inorganic compounds to derive both energy and electrons; CO₂ is the carbon source. Also called chemolithotrophic autotroph.

▶

- ## ▶ 2- **Photoorganoheterotroph**
- ▶ A microorganism that uses light energy, organic electron sources, and organic molecules as a carbon source. Also called photoorganotrophic heterotroph.

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▶ 3- **Chemolithoautotrophs**

- ▶ A microorganism that uses reduced inorganic compounds to derive both energy and electrons; organic molecules are used as the carbon source.

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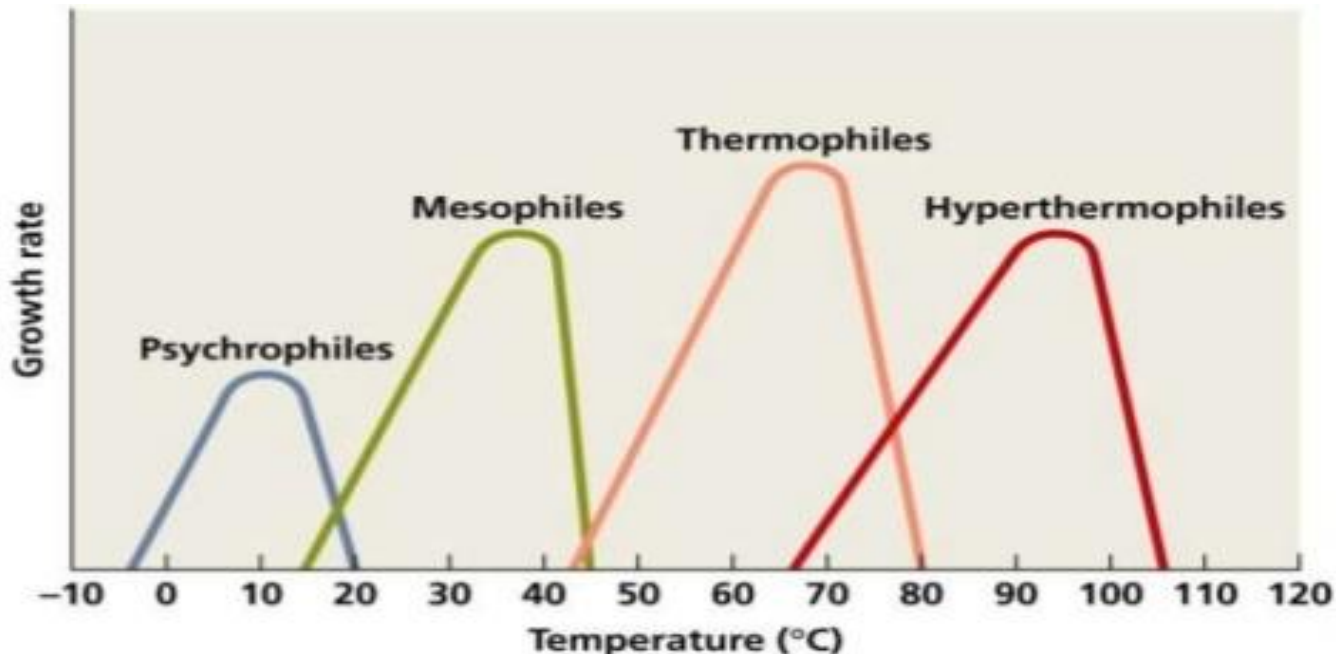
▶ 4- **Chemoorganoheterotrophs**

- ▶ An organism that uses organic compounds as sources of energy, electrons, and carbon for biosynthesis. Also called chemoheterotroph and chemoorganotrophic heterotroph.

Physical requirements microbial growth

Factors influence microbial growth

- ▶ **1- Temperature**
- ▶ Certain physical conditions affect the type and amount of microbial growth.
- ▶ For example, enzyme activity depends on the temperature of the environment, and microorganisms are classified in different groups according to their temperature requirement for growth.
- ▶ Bacteria have a minimum, maximum and **optimum growth temperature**.

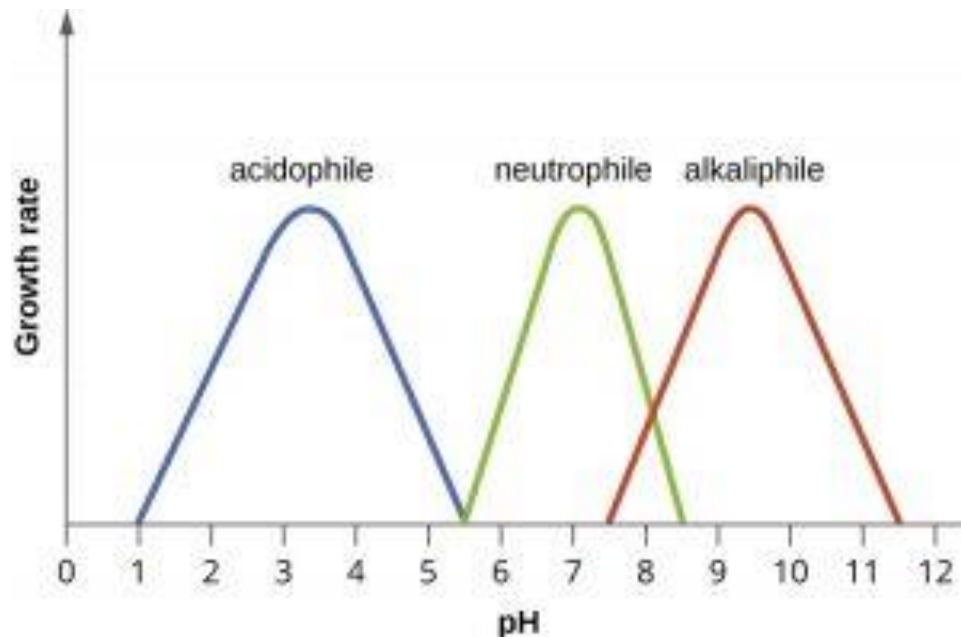


Physical requirements microbial growth

Factors influence microbial growth

▶ 1- pH

- ▶ Another physical requirement is the extent of acidity or alkalinity, referred to as the **pH** of a solution. For most bacteria, the optimum pH is between 6.5 and 7.5. Since the pH of most human tissue is 7.0 to 7.2, these **neutrophilic** bacteria usually grow well in the body. Certain bacteria, such as those in sauerkraut and yogurt, prefer acidic environments of 6.0 or below. These bacteria are said to be **acidophilic**. Molds and yeasts are among other common acidophilic microorganisms.



Physical requirements microbial growth

Factors influence microbial growth

▶ 3- Osmotic pressure

- ▶ Microbial growth proceeds best when the **osmotic pressure** is ideal.
- ▶ Normally, the salt concentration of microbial cytoplasm is about 1 percent.
- ▶ When the external environment also has a 1 percent salt concentration, then the osmotic pressure is optimum.
- ▶ Should the external salt concentration rise, as when food is salted, water will flow out of the microbial cytoplasm by osmosis through the cell membrane into the environment, thereby causing the microorganisms to shrink and die.
- ▶ By comparison, if exterior water is free of salt, it will flow through the cell membrane into the cytoplasm of the cell, causing the organism to swell and burst.
- ▶ Microorganisms that live in marine environments can tolerate high salt concentrations. These organisms are said to be **halophilic**. They include diatoms and dinoflagellates, two types of unicellular algae that lie at the base of oceanic food chains.
- ▶ There are many other species of halophilic bacteria, fungi, protozoa, and algae.

Physical requirements microbial growth

- ▶ **4- Oxygen:** Bacteria show a great deal of variation in their requirements for gaseous oxygen. Most can be placed in one of the following groups:
 - ▶ 1. **Obligate aerobes** are organisms that grow only in the presence of oxygen. They obtain their energy through aerobic respiration .
 - ▶ 2. **Microaerophils** are organisms that require a low concentration of oxygen (2% to 10%) for growth, but higher concentrations are inhibitory. They obtain their energy through aerobic respiration .
 - ▶ 3. **Obligate anaerobes** are organisms that grow only in the absence of oxygen and, in fact, are often inhibited or killed by its presence. They obtain their energy through anaerobic respiration or fermentation .
 - ▶ 4. **Aerotolerant anaerobes** , like obligate anaerobes, cannot use oxygen to transform energy but can grow in its presence. They obtain energy only by fermentation and are known as obligate fermenters.
 - ▶ 5. **Facultative anaerobes** are organisms that grow with or without oxygen, but generally better with oxygen. They obtain their energy through aerobic respiration if oxygen is present but use fermentation or anaerobic respiration if it is absent.